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VP-7721A

AUDIO ANALYZER
SERVICE MANUAL

MANUAL PART NUMBER
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AUDIO ANALYZER

VP－7721A

SERVICE MANUAL

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TABLE OF CONTENTS

1. CIRCUIT DESCRIPTION

1.1 INTRODUCTION 1-1

1.2 RC OSCILLATOR A5 1-1

1.2.1 General 1-1

1.2.2 OSC amplifier A5 1-2

1.2.3 Bridged-T circuit 1-2

1.2.4 Capacitance multiplier 1-3

1.2.5 ALC circuit 1-4

1.2.6 Peak detection circuit 1-4

1.2.7 Sample-and-hold circuit and sampling timing 1-5

1.2.8 Difference amplifier, high-speed ALC and low-speed ALC 1-5

1.2.9 Output OFF switch 1-6

1.2.10 Output sttenuator 1-6

1.3 ANALYZER A6, A7, A8 1-8

1.3.1 General 1-8

1.3.2 Input attenuator ATT1 1-9

1.3.3 Preamplifier A6 1-9

1.3.4 Composite amplifier A7 1-9

1.3.5 Input level detector A7 1-10

1.3.6 Level meter range attenuator ATT2 1-11

1.3.7 First and second notch filters 1-11

1.3.8 Automatic tuning circuit 1-13

1.3.9 Level meter range attenuator ATT3 1-13

1.3.10 Low-pass and high-pass filters 1-13

1.3.11 750 kHz low-pass filter 1-13

1.3.12 Level meter range attenuators ATT4 and ATT5 1-13

1.3.13 MONITOR output terminal 1-14

1.3.14 RMS converter U23 1-14

1.3.15 Ratio circuit 1-17

1.3.16 V-F converter 1-18

1.3.17 Level meter drive circuit 1-18

1.3.18 Overload detector 1-19

1.3.19 Relative reference circuit 1-19

1. CIRCUIT DESCRIPTION

1.1 INTRODUCTION

The VP-7721A circuit consists of the RC oscillator as the signal source for measurement, analyzer mainly consisting of the distortion meter, controller, control interface and display. The programmable oscillator and analyzer are operated by digital control signals from the controller using a microprocessor.

1.2 RC OSCILLATOR A5

1.2.1 General

Fig. 1-1 shows the RC oscillator block diagram in which the bridged-T oscillation system is used.

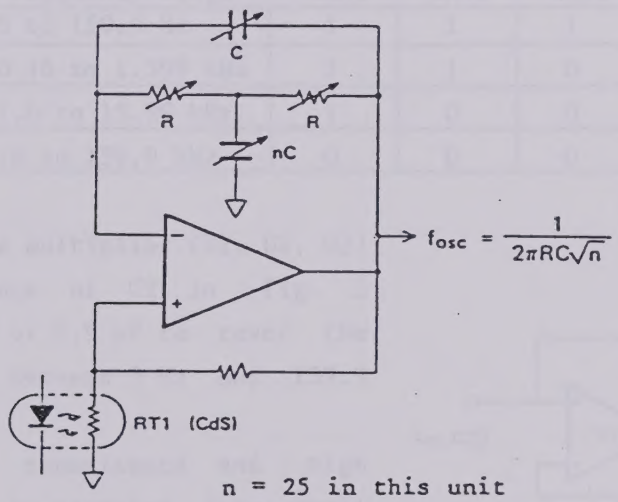


Fig. 1 Bridged-T oscillator

The oscillation frequency range is 5 Hz to 159.9 kHz. The desired frequency can be selected by changing settings of resistors "R" and capacitors "C" in Fig. 1.

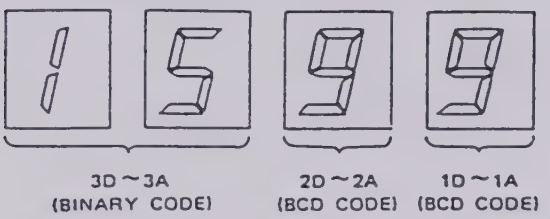
The bridged-T oscillator requires an output amplitude stabilizer circuit to ensure low-distortion signal generation at a constant amplitude. The unit adopts the ALC (automatic level control) circuit using a photocoupler (LED-CdS) as the control element.

Table 1-1 Internal control signals for oscillation frequency

a. Signal kind

Fosc	1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D, 3A,3B, 3C, 3D Total: 12 bits
F_{RANGE}	RAN1, RAN2, RAN3 Total: 3 bits

b. Fosc signals and displays



Positive logic ("1": 5 V, "0": 0 V)

c. F_{RANGE} signals and frequency range settings

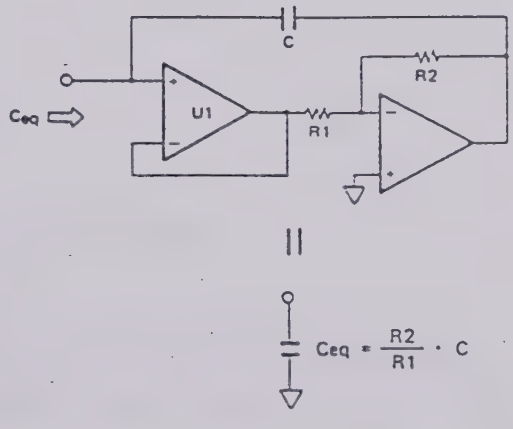
Frequency range	RAN1	RAN2	RAN3
5 to 159.9 Hz	1	1	1
0.16 to 1.599 kHz	1	1	0
1.6 to 15.99 kHz	1	0	0
16 to 159.9 kHz	0	0	0

1.2.4 Capacitance multiplier (U1, U2, U3)

The capacitance of C2 in Fig. 2 should be 9 µF or 0.9 µF to cover the frequency range between 5 Hz and 159.9 kHz.

Since large capacitance and high accuracy cannot be expected from small inexpensive capacitors, this instrument adopts a capacitance multiplier circuit as an equivalent circuit for large capacitance.

U1, U2 and U3 in the circuit diagram form this equivalent circuit. Fig. 3 shows the capacitance multiplier circuit and the equivalent capacitance.



R2/R1 = 9 in this circuit.

Fig. 3 Capacitance multiplier

1.2.7 Sample-and-hold circuit and sampling timing

The sample-and-hold circuit samples the peak value in each cycle of the input wave and holds the output at that level until sampling for the next cycle. It consists of U13 and holding capacitor C37. Fig. 5 shows the discharge timing in the preceding paragraph and the sampling timing. Monostable mutivibrator U15 generates sampling and discharge pulses.

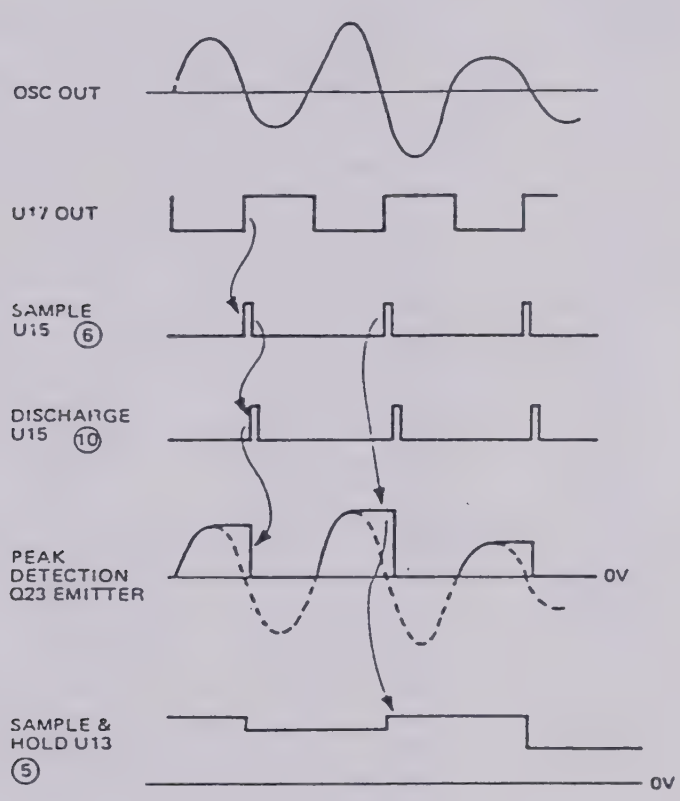


Fig. 5 Sampling and discharge timing

1.2.8 Difference amplifier, high-speed ALC and low-speed ALC

U12 is a difference amplifier. The difference between the sample-and-hold signal applied to U12 and the reference voltage is amplified here and sent to the next stage.

The ALC loop of this unit consists of the high-speed ALC path and low-speed ALC path. The high-speed path applies the same output to U11 via U12. These two paths are provided to minimize distortion by the ALC loop together with high-speed amplitude stabilization.

Table 1-2 Internal control signals for output attenuators

a. Signal kinds

ATT A, B, C, D, E, F, G, H, I and J (Total) 10 bits

b. Relations with Display (F to J)

Attenuation (dB)	J	I	H	G	F	Display (dBV)
0 to 2.4	0	0	0	0	0	4.0 to 1.6
2.5 to 4.9	0	0	0	0	1	1.5 to -0.9
5.0 to 7.4	0	0	0	1	0	-1.0 to -3.4
7.5 to 9.9	0	0	0	1	1	-3.5 to -5.9
10.0 to 12.4	0	0	1	0	0	-6.0 to -8.4
12.5 to 14.9	0	0	1	0	1	-8.5 to -10.9
15.0 to 17.4	0	0	1	1	0	-11.0 to -13.4
17.5 to 19.9	0	0	1	1	1	-13.5 to -15.9
20.0 to 22.4	0	1	0	0	0	-16.0 to -18.4
22.5 to 24.9	0	1	0	0	1	-18.5 to -20.9
25.0 to 27.4	0	1	0	1	0	-21.0 to -23.4
27.5 to 29.9	0	1	0	1	1	-23.5 to -25.9
30.0 to 32.4	0	1	1	0	0	-26.0 to -28.4
32.5 to 34.9	0	1	1	0	1	-28.5 to -30.9
35.0 to 37.4	0	1	1	1	0	-31.0 to -33.4
37.5 to 39.9	0	1	1	1	1	-33.5 to -35.9
40.0 to 42.4	1	0	0	0	0	-36.0 to -38.4
42.5 to 44.9	1	0	0	0	1	-38.5 to -40.9
45.0 to 47.4	1	0	0	1	0	-41.0 to -43.4
47.5 to 49.9	1	0	0	1	1	-43.5 to -45.9
50.0 to 52.4	1	0	1	0	0	-46.0 to -48.4
52.5 to 54.9	1	0	1	0	1	-48.5 to -50.9
55.0 to 57.4	1	0	1	1	0	-51.0 to -53.4
57.5 to 59.9	1	0	1	1	1	-53.5 to -55.9
60.0 to 62.4	1	1	0	0	0	-56.0 to -58.4
62.5 to 64.9	1	1	0	0	1	-58.5 to -60.9
65.0 to 67.4	1	1	0	1	0	-61.0 to -63.4
67.5 to 69.9	1	1	0	1	1	-63.5 to -65.9
70.0 to 72.4	1	1	1	0	0	-66.0 to -68.4
72.5 to 74.9	1	1	1	0	1	-68.5 to -70.9
75.0 to 77.4	1	1	1	1	0	-71.0 to -73.4
77.5 to 79.9	1	1	1	1	1	-73.5 to -75.9

c. 0.1 dB step division of each 2.5 dB range at left

Attenuation (dB)	E	D	C	B	A
0.0	0	0	0	0	0
0.1	0	0	0	0	1
0.2	0	0	0	1	0
0.3	0	0	0	1	1
0.4	0	0	1	0	0
0.5	0	0	1	0	1
0.6	0	0	1	1	0
0.7	0	0	1	1	1
0.8	0	1	0	0	0
0.9	0	1	0	0	1
1.0	0	1	0	1	0
1.1	0	1	0	1	1
1.2	0	1	1	0	0
1.3	0	1	1	0	1
1.4	0	1	1	1	0
1.5	0	1	1	1	1
1.6	1	0	0	0	0
1.7	1	0	0	0	1
1.8	1	0	0	1	0
1.9	1	0	0	1	1
2.0	1	0	1	0	0
2.1	1	0	1	0	1
2.2	1	0	1	1	0
2.3	1	0	1	1	1
2.4	1	1	0	0	0

Positive logic ('1':5 V, '0':0 V)

Each component circuit of the analyzer of the instrument is programmable, and the control circuit mainly consisting of the microprocessor establishes the necessary combination for each measurement.

1.3.2 Input attenuator ATT1

The 20 dB and 10 dB attenuators attenuate the input signal level by 0, 10, 20 or 30 dB. For attenuator control, the control signal from the microprocessor is decoded by input range decoder U8.

1.3.3 Preamplifier A6 (Q1 through Q14 and Q15 through Q28)

The preamplifier consists of two low-distortion, wide-band operational amplifiers as shown in the block diagram, Fig. 1-2.

When measuring the signal with the input floating system, the signal is fed to two inputs A and B activating both operational amplifiers. When measuring the signal with the input the non-floating system, the relay K1 is turned on, the signal is fed only to input A and the operational amplifier on the input A side is activated.

The amplification rate of the operational amplifier is switched to 0 dB, +10 DB or +20 dB according to the input level. The gain of input A and B sides (abbreviated as Ga and Gb, respectively) are as follows:

- Relays K4 and K5 are on:
  Ga = 1, Gb = 1
- Relay K4 is on and K5 is off:
  Ga = (R37 + R34)/R37, Gb = (R74 + R72)/R74
- Relay K5 is on and K4 is off:
  Ga = (R36 + R34)/R36, Gb = (R73 + R72)/R73

1.3.4 Composite amplifier A7 (Q1 through Q14)

The outputs from two amplifiers are composed in this stage. Decoder U8 manages switching of the input attenuator and preamplifier systems to be activated. The input between 100 V to 0.1 V is converted to proper level for the succeeding circuits to operate--3 V to 1 V.

When measuring the signal with the input non-floating system, relay K1 goes on and the composite amplifier is bypassed (see Fig. 1-3).

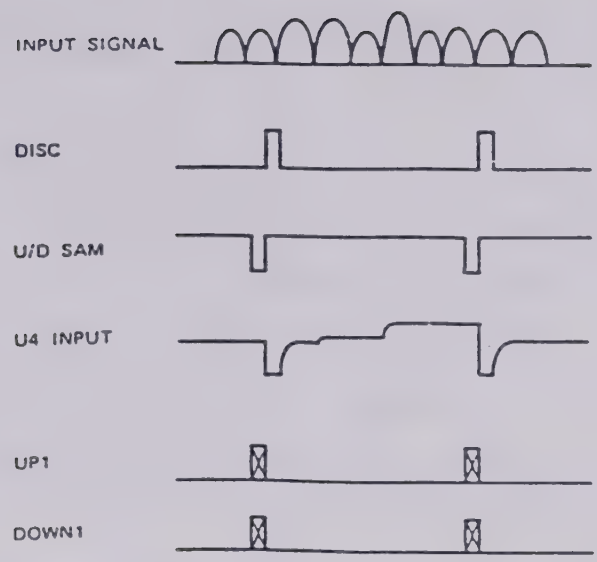


Fig. 10 Auto ranging timing chart

Note 1: The status of the input signal level with respect to the set range is judged by the status of UP1 and DOWN1 when the U/D SAM is low (0 V).

	UP1	DOWN1
Proper range	0	0
Input over	1	0
Input under	0	1

Note 2: The DISC and U/D SAM pulses are not synchronized with the input signal frequency.

1.3.6 Level meter range attenuator ATT2

The 0 or 40 dB attenuator is switched over by relay K7. The switching is controlled with level meter range decoder U9.

1.3.7 First and second notch filters

Our patented modified Wien bridge type notch filters are used in the instrument. Two notch filters are cascade connected and multiple positive feedback is supplied from the output of the second stage to both the first and second notch filters. This arrangement ensures broad and sharp band rejection characteristics.

In the LEVEL or S/N mode, switches K10 and K1 are closed to form a flat amplifier consisting of U103 and U9.

1.3.8 Automatic tuning circuit

To change the tuning frequency of the notch filter shown in Fig. 12, R0 and C0 are selected by 12-bit and 3-bit control signals, respectively. Since optimal tuning to the input frequency is impossible only with this arrangement, the automatic tuning circuit is installed to carry out fine tuning. In the automatic tuning circuit, the input and output signals of the first notch filter are subject to synchronized detection by balanced modulator consisting of U107 and 112. Feedback control of variable resistors RT1 and RT2 is carried out so as to make the phase difference to zero.

1.3.9 Level meter range attenuator ATT3

The 0 dB and 20 dB attenuator is switched by analog switch U104 and is controlled by level meter range decoder U9.

1.3.10 Low-pass and high-pass filters

Low-pass filters shown in Fig. 1-4 whose -3 dB cutoff frequencies are 30 kHz and 80 kHz, and a high-pass filter with 400 kHz cutoff frequency are used. These are active filters with 60 dB/decade (= 18 dB/octave) roll-off characteristics. Filter connections are selected by the analog switch. The control signal is in the negative logic (filter ON at 0 V).

1.3.11 750 kHz low-pass filter

The filter limits the flatness characteristics of the instrument to 750 kHz. It eliminates unnecessary noise.

1.3.12 Level meter range attenuators ATT4 and ATT5

The 0, 10 and 20 dB attenuators are switched by analog switches U19 and U22 and controlled by level meter range decoder U9. ATT2 through ATT5 attenuate the level meter range in 10 dB steps up to 90 DB. While, amplifiers A7 U103, A8 U9 and A8 U21 provide total of 80 dB gain. Table 1-3 shows the relationship between control signals, measurement range and ATT setting.

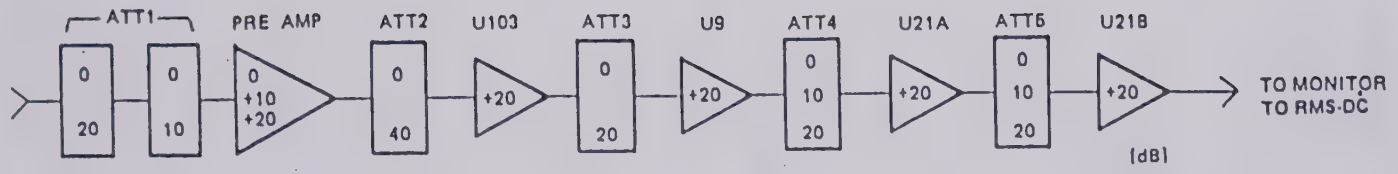


Table 1-3 Range control signals and ATT settings

LEVEL MODE RANGE		CONTROL SIGNAL C B A	CONTROL SIGNAL R4 R3 R2 R1	ATT 1 O/P	PRE AMP O/P	ATT 2 O/P	U103 O/P	ATT 3 O/P	U9 P/P	ATT 4 O/P	U21A O/P	ATT 5 O/P	U21B O/P
40dB	100V	1 0 1	1 0 0 1	30dB 3V	0dB 3V	40dB 30mV	0.3V	20dB 30mV	0.3V	10dB 0.1V	1V	20dB 0.1V	1V
30	30	1 0 0	1 0 0 1	20 3	0 3	40 30	0.3V	20 30	0.3	10 0.1	1	20 0.1	1
20	10	0 1 1	1 0 0 1	10 3	0 3	40 30	0.3V	20 30	0.3	10 0.1	1	20 0.1	1
10	3	0 1 0	1 0 0 1	0 3	0 3	40 30	0.3V	20 30	0.3	10 0.1	1	20 0.1	1
0	1	0 0 1	1 0 0 1	0 1	+10 3	40 30	0.3V	20 30	0.3	10 0.1	1	20 0.1	1
-10	0.3	0 0 0	1 0 0 1	0 0.3	+20 3	40 30	0.3V	20 30	0.3	10 0.1	1	20 0.1	1
(0)	(1V)	(0 0 1)	(1 0 0 1)										
(-10)	(0.3V)	(0 0 0)	(1 0 0 1)										
-20	100mV	0 0 0	1 0 0 0	0 100mV	+20 1	40 10	0.1	0 100	1	20 0.1	1	20 0.1	1
-30	30	0 0 0	0 1 1 1	0 30	+20 0.3	40 3	0.03	0 30	300mV	10 0.1	1	20 0.1	1
-40	10	0 0 0	0 1 1 0	0 10	+20 0.1	40 100	1	20 100	1000	20 0.1	1	20 0.1	1
-50	3	0 0 0	0 1 0 1	0 3	+20 30mV	0 30	300mV	20 30	300	10 0.1	1	20 0.1	1
-60	1	0 0 0	0 1 0 0	0 1	+20 10	0 10	100	0 100	1000	20 0.1	1	20 0.1	1
-70	0.3	0 0 0	0 0 1 1	0 0.3	+20 3	0 3	30	0 30	300	10 0.1	1	20 0.1	1
-80	0.1	0 0 0	0 0 1 0	0 0.1	+20 1	0 1	10	0 10	100	0 0.1	1	20 0.1	1
(-90)	(0.03)												

1.3.15 Ratio circuit

To measure the S/N or distortion factor, it is necessary to drive the level meter according to the ratio of the noise or distortion voltage. Either the set level operation or ratio circuit is used to calculated the ratio. The latter method is adopted in the VP-7721A.

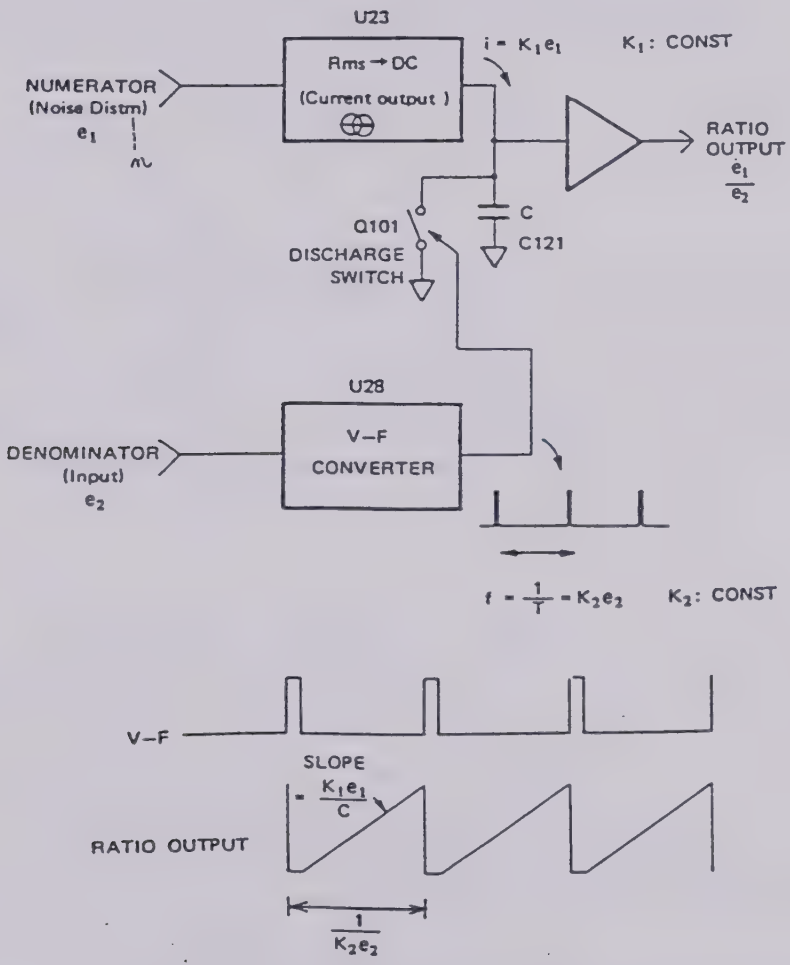


Fig. 13 Ratio circuit block diagram

In the circuit, the discharge pulse cycle of C121 varies in inverse proportion to input level e2 to the ratio circuit. Cycle T decreases as input level increases. On the contrary, T increases as the input level decreases. Assume that a signal is applied to the numerator side with T kept at a constant level. The higher the level, the quicker the charging speed.

1.3.18 Overload detector

A detector for automatic ranging same as that in 1.3.4 is provided for the output of the ratio circuit. It consists of comparator U27 and switches Q104 and Q106. The operation is similar to that in 1.3.4.

1.3.19 Relative reference circuit

This function is operated by changing the DC voltage on the nominator side of the ratio circuit by variable resistor R178 in the level mode.

1.4 CONTROLLER

1.4.1 General description

The controller controlled by the microprocessor sends control signals for panel operation, analyzer and oscillator. The controller consists of controller A and controller B as shown in Fig. 1-5. Controller A consists of the microprocessor, ROM, RAM, etc. While controller B consists of the I/O interface circuit, microprocessor control circuit, etc. See the block diagram for better understand the operation explained below.

1.4.2 Controller A

When the measurement conditions are established in the instrument, the microprocessor operation stops to prevent noise during measurement.

Upon receiving the start signal from the microprocessor control circuit, the clock generator starts. When the signal from the reset counter is received, the microprocessor starts program execution.

After processing input data according to the contents of the ROM (4k bytes) and RAM (2k bytes), data setting to each latch of controller B and panel display are carried out.

Then, any further processing request queued during processing of the current data is checked. If any, processing restarts from processing judgement. When there is no more request, the end signal is sent to the microprocessor control circuit of controller B to terminate execution. Fig. 15 shows the general flowchart.

1.4.3 Controller B

Controller B consists of the I/O interface circuit such as the output latch and input encoder, microprocessor control circuit and timing control circuit such as zero-cross circuit.

Microprocessor circuit: Generates the microprocessor start signal when some processing request arise. Processing request contents are as follows:

- Power ON
- Keying and status input from panel
- Rotary encoder input
- UP/DOWN processing request from analyzer
- S/N hold switching process
- Remote input

When any of the above conditions arises, the microprocessor control circuit ANDs it to determine if processing is required or not. If necessary, it changes the start signal to high to start the microprocessor of controller A. The start signal goes to low upon receiving of the end signal from the microprocessor to stop its operation.

Timing generator circuit: Generates the sample signal for automatic measurement range switching and sends it to analyzers A and B. The sample signal is also used as the clock for S/N holding time.

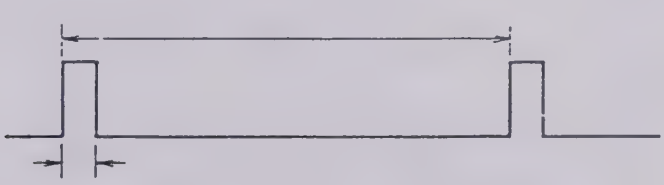


Fig. 16 Sample signal

Hold counter circuit: Counts the S sampling time at the time of S/N measurement (about 1.5 seconds).

Zero-cross circuit: Receives the signal from the oscillator and switches the control signals to the oscillator and analyzer at the zero cross timing of the signal.

2. VP-7721A ADJUSTMENT PROCEDURE

1. PREPARATION

1.1 Test Equipment Required

The test equipment listed below are required for adjusting the VP-7721A. Always use calibrated equipment after warming up.

Table 1 Test equipment and fixtures Required

Equipment	Specification	Applicable model
Oscilloscope	Bandwidth : DC to 15 MHz or more Sensitivity : 5 mV / div or more	VP-5505B
Frequency counter	Frequency range : 5 Hz to 300 kHz	VP-4621A, VP-4545A
AC differential voltmeter	Range : 5 Hz to 2 MHz	Fluke 931A, 931B or equivalent
AC voltmeter	Range : 10 Hz to 10 MHz	VP-960A
Distortion meter	Frequency : 5 Hz to 160 kHz Sensitivity : 0.3 Vrms or more Measurement range : 0.01 % of full scale or more	VP-7702C
Resistor attenuator	Attenuation : 79.9 dB in 0.1 dB / step or more Impedance : 600 Ω	Ando AL-205 or equivalent
AC voltmeter calibrator	Calibration output : 1 kHz, 1000 V ±0.3 %	Ballentain 421A
Low-frequency oscillator	Wide band : 10 Hz to 10 MHz Low distortion : 5 Hz to 99.9 kHz, 100 kHz to 500 kHz	HP 652A or equivalent, VP-7720C and VP-7201A, respectively
Spectrum analyzer	Range : 10 Hz to 50 kHz, 70 dB or more 50 kHz to 600 kHz, 70 dB or more	
Digital voltmeter	Range : 1 kHz, AC / DC measurement	VP-2650A
LCR meter		Techtronics 130 or equivalent
LPF box (jig)	Cut-off frequency : 15, 20, 50, 100, 150 kHz	
600 Ω and 50 Ω terminators (jigs)	Accuracy : Within ±1 %	
Coaxial cable and shield wire for floating connection (jigs)		
Resistor (jig)	Resistance : 100 kΩ ±1 %	

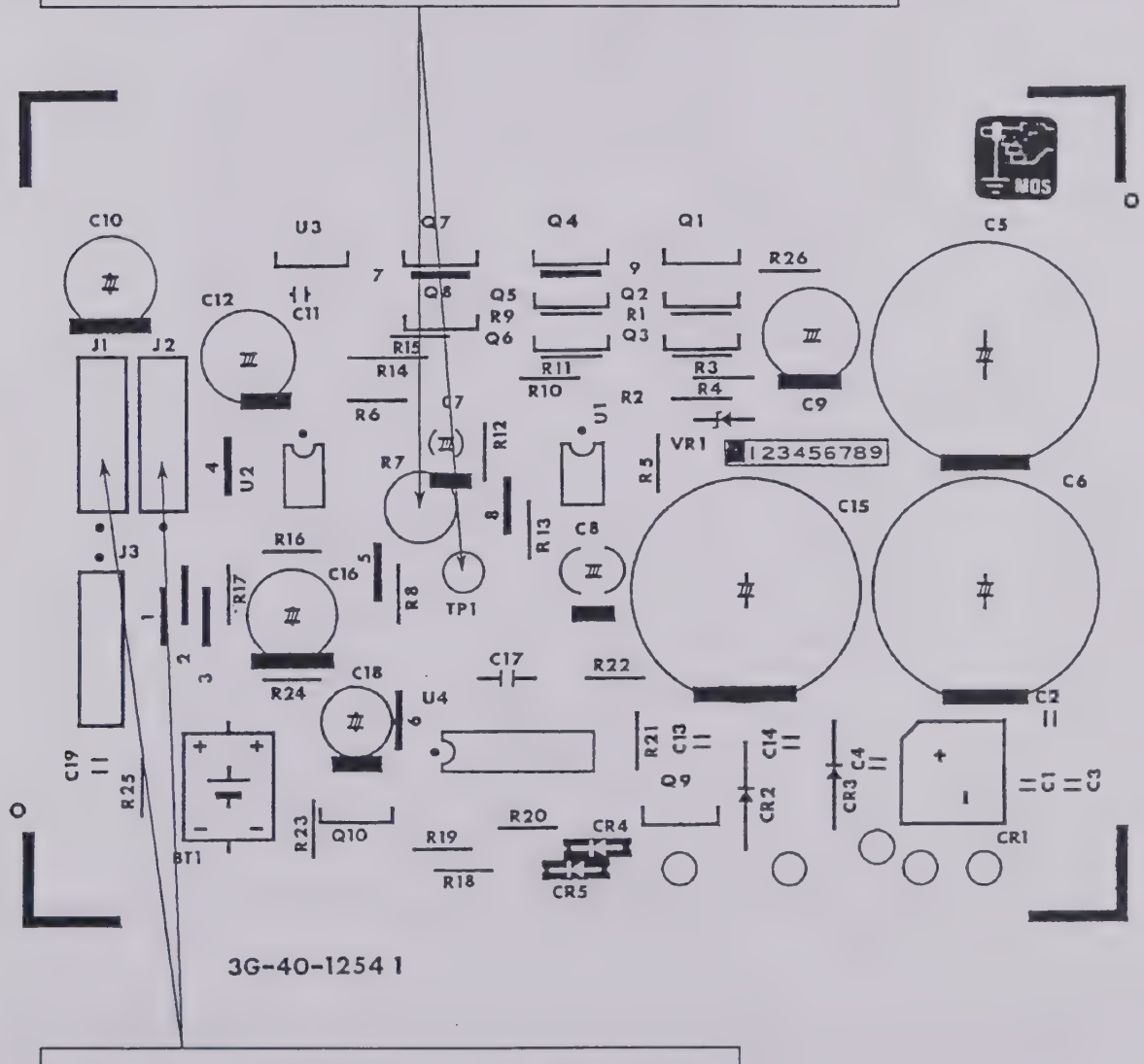
2. POWER SUPPLY

2.1 Power Supply Voltage Adjustment

CAUTION

Since the chassis is floated from the ground of the power supply circuitry, never use the chassis as the ground for measurements.

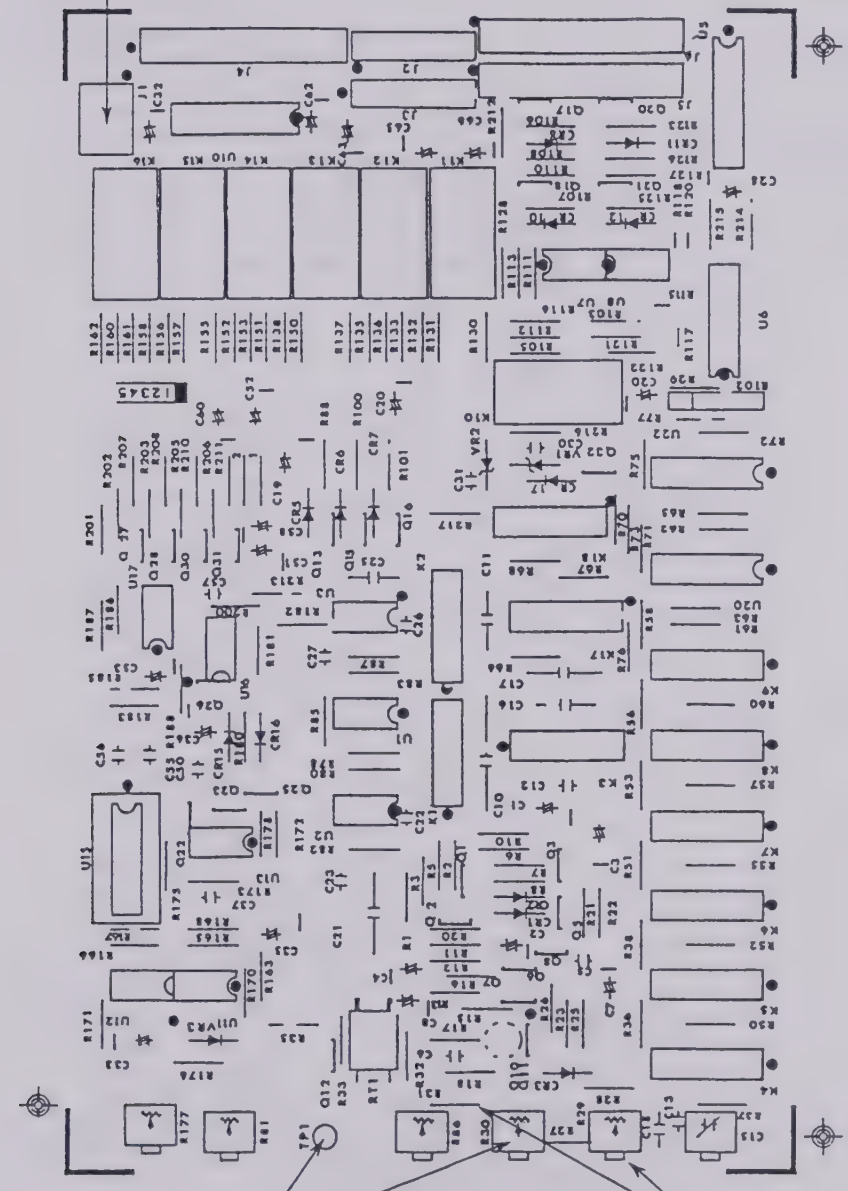
(1) Connect the digital voltmeter to TP1.
Adjust control R7 (15V ADJ) so that the voltage is +15 V ±20 mV.



(2) Check that 5 ±0.5 V, −5 ±0.5 V and −15 ±0.1 V are output to pins 2, 3 and 5 of connector J1 or J2.

3.3 Oscillation Check and Cds Voltage and Offset Adjustments

(1) Set the frequency to 10 kHz. Check the oscillation between pins ① and ② of J1, using the oscilloscope.



≪OSC≫

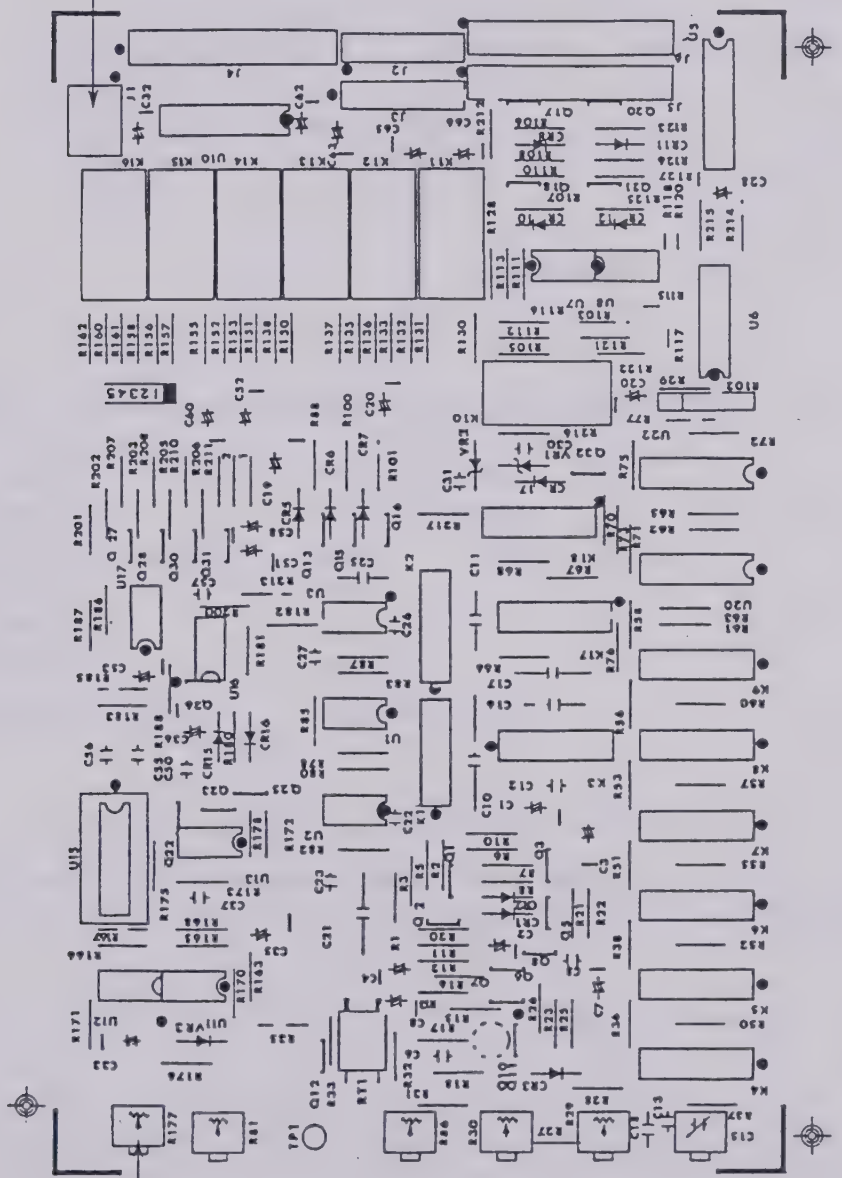
(2) Set the frequency to 1 kHz. Measure voltage between TP1 and common using the oscilloscope. Adjust R30 so that the measured voltage is +2.0 V.

(3) Connect the oscilloscope to R31. Adjust R29 so that the positive and negative peaks of the waveform are at the same level.

3.5 Output Voltage Adjustment

(1) Connect the differential voltmeter to the output terminal and terminate it with a 600 Ω terminator.

600 Ω terminator



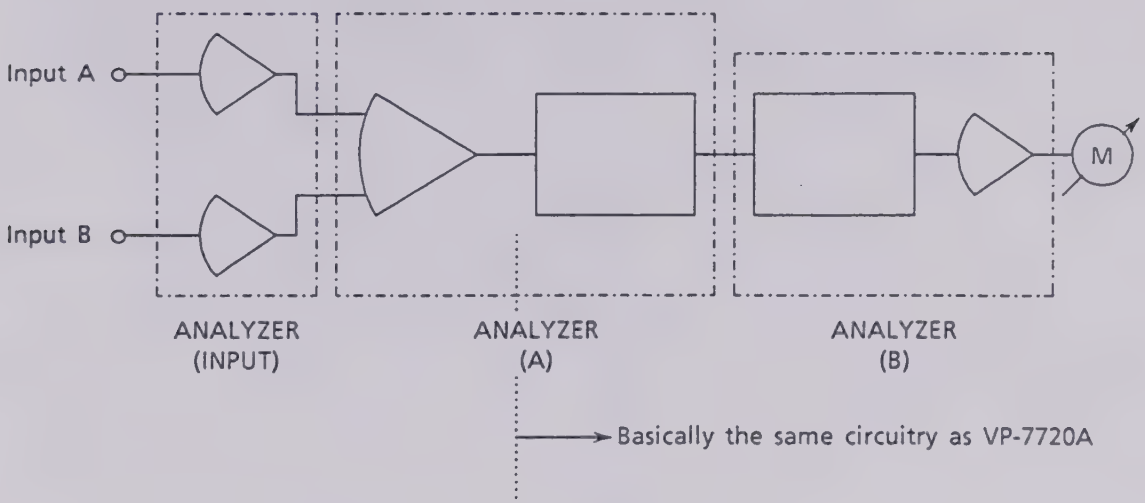
≪OSC≫

(2) Adjust R177 for an output voltage of 1.58 Vrms. The frequency used for adjustment is 1 kHz.

4. ANALYZER

4.1 General

The simplified block diagram of the analyzer portion is as shown below.

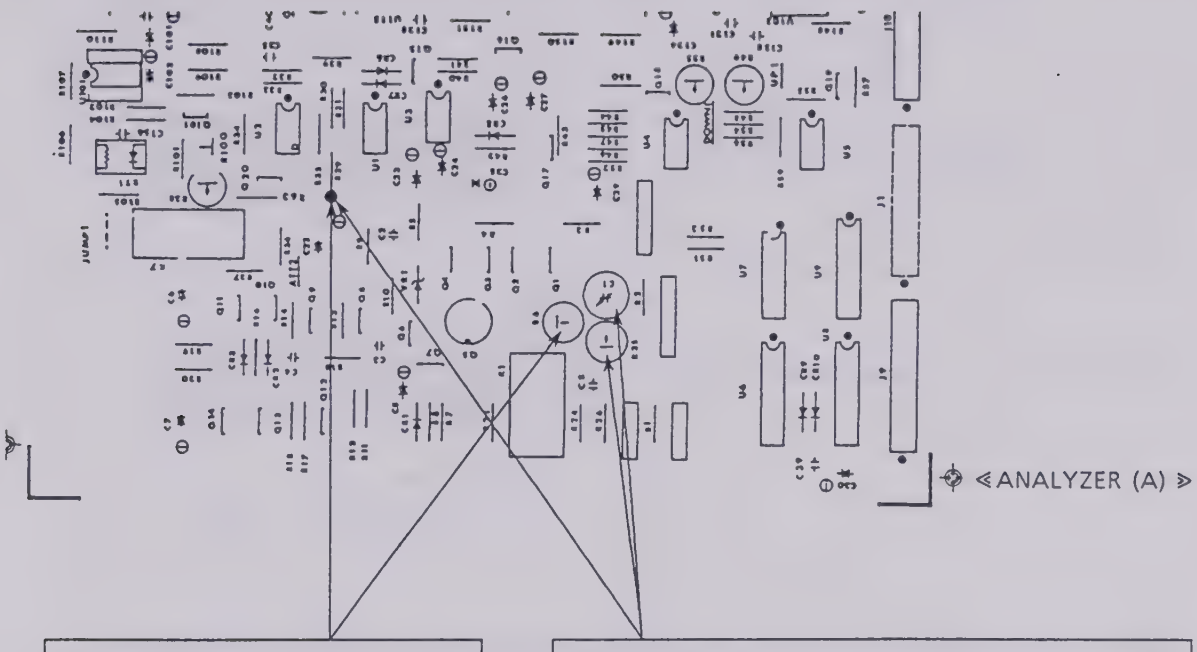


Settings for adjustments are as follows, unless otherwise specified :

(1) OSC frequency : 1.000 kHz
(2) MODE : FREQ or AMPTD
(3) OSC OUTPUT : 4.0 dB (= 6.2 dBm)
(4) MEASURE : LEVEL
(5) FILTER : OFF
(6) REF ADJ : OFF
(7) RANGING : MANUAL
(8) INPUT SELECT : 2 (non-floating)

NOTE

Unless a doubt is ascertained, the built-in oscillator can be used as the signal source.



(6) Next, connect the oscilloscope to the output point (R29) of the input amplifier of ANALYZER (A). Adjust R6 so that the DC component is 0 V.

(8) Adjust R25 so that the common mode signal measured at the output point (R29) is the smallest. Next, change the frequency of wide-band oscillator between 100 and 500 kHz, and adjust trimmer C1 so that the common mode signal component is the smallest.

(7) Select the 3 V range and simultaneously supply 1 kHz, 3 V signals from the wide-band oscillator to input terminals A and B.

4.3 Filter Amplifier Offset Adjustment

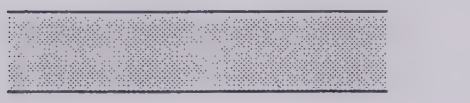
(1) Set the INPUT SELECT to ▽2 (non-floating) and supply a 3 V, 1 kHz signal from the low-distortion oscillator (built-in oscillator may be used) to the A input terminal.

(2) Set the MODE to DISTN, the input range, to 3 V, and tune with the input signal.

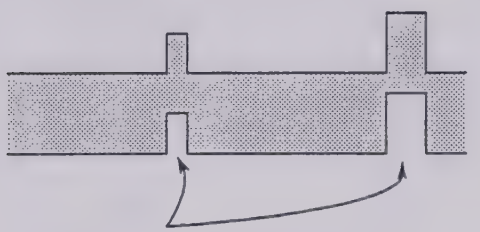
NOTE

For an external oscillator, fine adjust the oscillator frequency for tuning. Monitor the output point (TP4 on ANALYZER (B)) of the 2nd filter amplifier. If the fundamental harmonic remains, adjust R167 and R201 shown on Item 4.4.

(8) Monitor the same point as the previous step (TP6 on ANALYZER (B)). Connect the built-in oscillator to the A input terminal. Select the S / N mode and monitor the noise waveform.



(a) Normal noise waveform



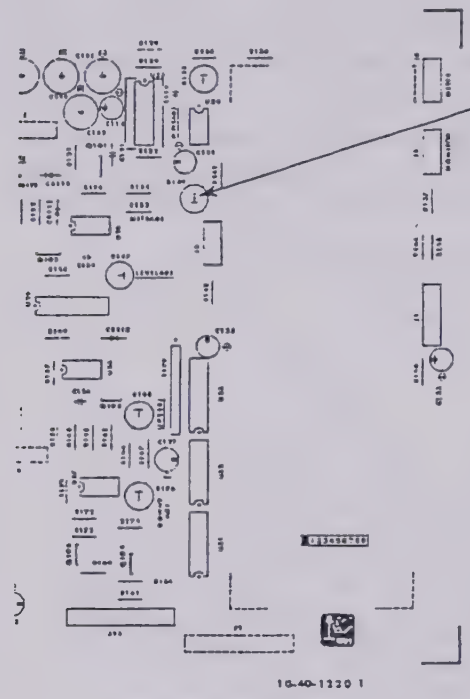
(b) Abnormal waveform (large IC noise)

If noise levels frequently shift as shown in figure (b) above, the noise of U103 (LF357) on ANALYZER (A) is excessive. In this case, exchange U103 on ANALYZER (A) with U9 on ANALYZER (B) and re-adjust according to steps (1) through (8).

4.5 Input Meter Accuracy Adjustment

(1) Set the INPUT SELECT to ▽2 (non-floating) and connect the AC voltage calibrator (Ballentain) to the A input terminal. Supply a 1 kHz, 3 Vrms signal to the input terminal.

(2) Set the measurement mode to LEVEL and the range, to 3 V (10 dB).

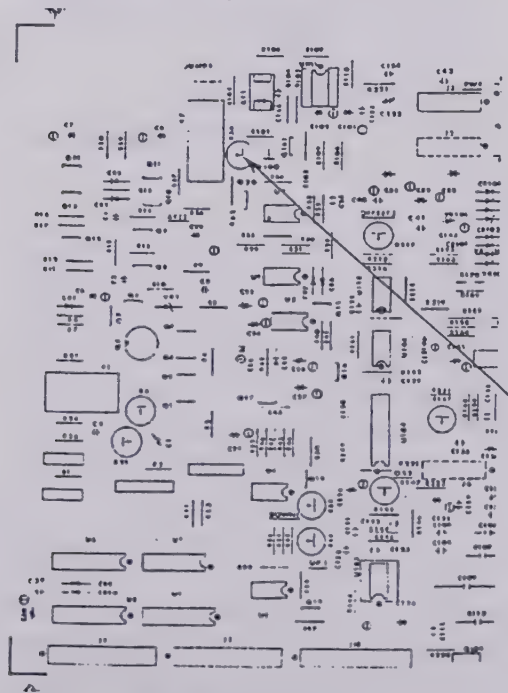


(3) Adjust R139 (M1 FS ADJ) so that the input meter (on the left-hand side) on the front panel reads 3.0.

(4) Open terminate the A input terminal. Set the range to 0.3 V and check that the input meter indicator is around 0. If the indicator deviates excessively, re-check the input offset explained in 4.2.

≪ANALYZER (B) ≫

4.6 40 dB Attenuator Adjustment



(1) Connect the AC voltage calibrator to the A input terminal. Supply a 1 kHz, 3 mVrms signal to the input terminal.

(2) Set the measurement mode to LEVEL and the range, to 3 mV. Memorize the meter reading at this time.

(3) Change the range to 3 V. Supply a 3 V signal from the calibrator. Adjust R38 so that the meter reads the same value as that in step (2).

≪ANALYZER (A) ≫

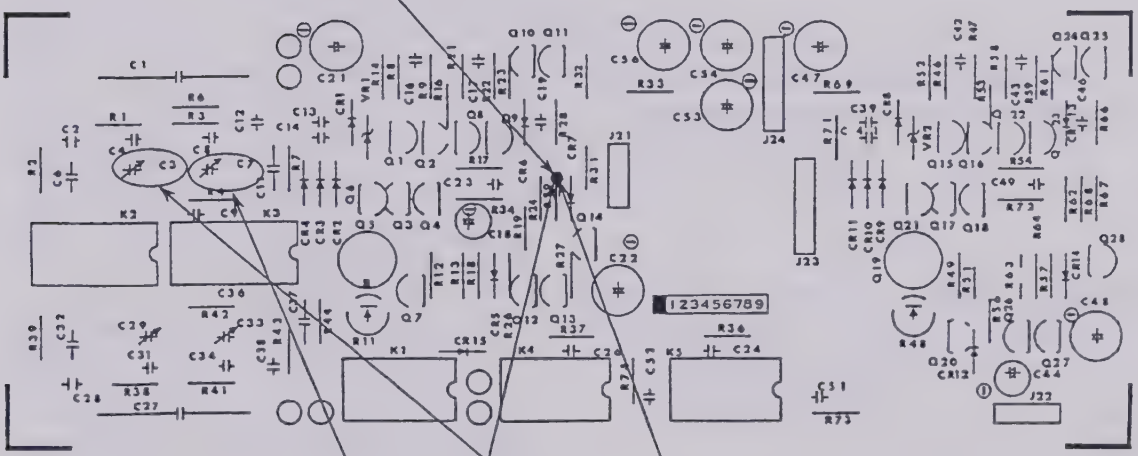
4.8 Input Attenuator Frequency Characteristic Adjustment

(1) Set the INPUT SELECT to ▽2 (non-floating) and connect the wide-band oscillator (HP652) to the A input terminal (50 Ω terminated). Supply a 1 kHz signal to the input terminal.

(2) Set the measurement mode to LEVEL and the meter range, to 3 V.

(3) Connect the wide-band AC voltmeter to the output point (R29) of the A amplifier. Set the range to 3 V and adjust the oscillator output for meter reading of about 90 % the full scale. Check flatness using the AC voltmeter when the oscillator frequency is changed all the way to 500 kHz (guideline: 0 dB at 100 kHz and within ±2 dB at 500 kHz).

NOTE : Use a connection cable which does not affect the flatness.



(4) Change the meter range to 10 V (20 dB) and the AC voltmeter range, to 1 V. Adjust C7 (10 dB ATT) so that the flatness is optimum when the oscillator output is changed from 1 kHz to 500 kHz.

(5) Change the meter range to 30 V (30 dB) and the AC voltmeter range, to 0.3 V. Adjust C3 (20 dB ATT) so that the flatness is optimum when the oscillator output is changed from 1 kHz to 500 kHz.

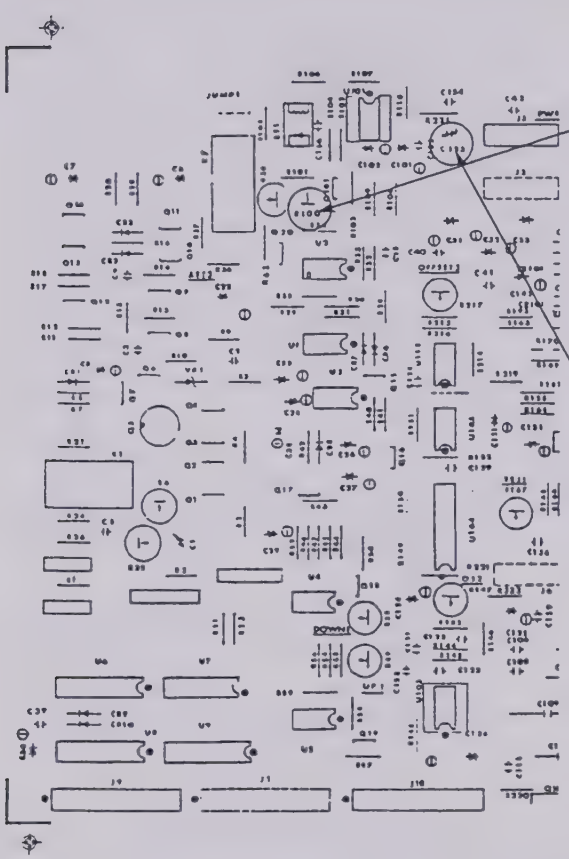
(6) Repeat steps (4) and (5) to check flatness of the meter 100 V (40 dB) range. The 100 V range flatness is affected both by C3 and C7 explained in steps (4) and (5). If specifications cannot be met, balance the flatness using two trimmers.

4.9 Harmonic Deviation Adjustment

4.9.1 2nd harmonic deviation adjustment

(1) Set the INPUT SELECT to ▽ (non-floating), connect the wide-band oscillator to the A input terminal and supply a 1 kHz, 3 Vrms signal. Set the measurement mode to DISTN and the input meter range, to 3 V.

(2) Set the tuning frequency to 500 Hz and the distortion meter range, to 100 % (0 dB).



≪ANALYZER (A)≫

(3) Adjust R100 so that the distortion meter reads −0.3 dB (0.97 on the scale).

(4) Change the wide-band oscillator frequency to 160 kHz and the tuning frequency, to 80 kHz.

(5) Adjust trimmer C153 so that the distortion meter reads 0 dB or as close to 0 dB as possible.

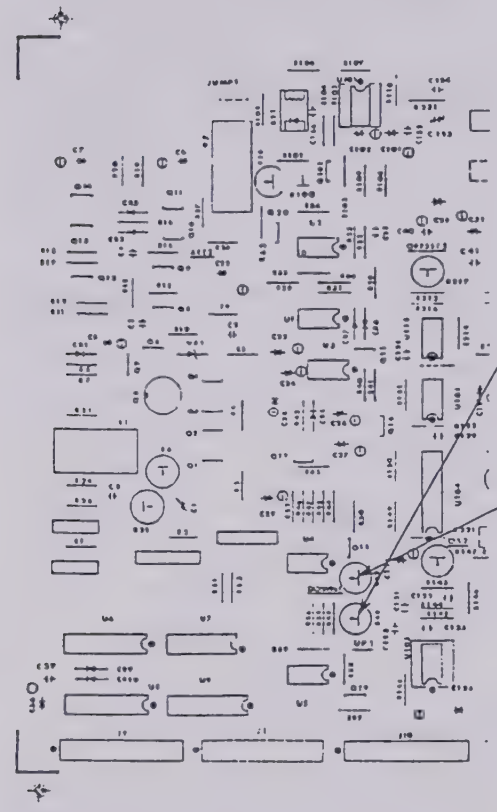
(6) Check the second harmonic deviation throughout the entire bandwidth at input signal voltage of 3 V and input meter range of 3 V.

4.10 AUTO RANGE Switching Point Adjustment

(1) Set the INPUT SELECT to ▽2 (non-floating), connect the AC voltage calibrator to the A input terminal and supply a 1 kHz, 1.07 V signal.

(2) Set the measurement mode to DISTN and the RANGING, to AUTO.

(3) At this time, the input meter reads 1.07 V (at input meter range of 1 V).



≪ANALYZER (A)≫

(4) Slowly turn R49 (UP1) and stop it when the input meter range changes from 1 V to 3 V range.

(5) With the 3 V range condition of step (4), change voltage of the voltage calibrator to 0.8 V.

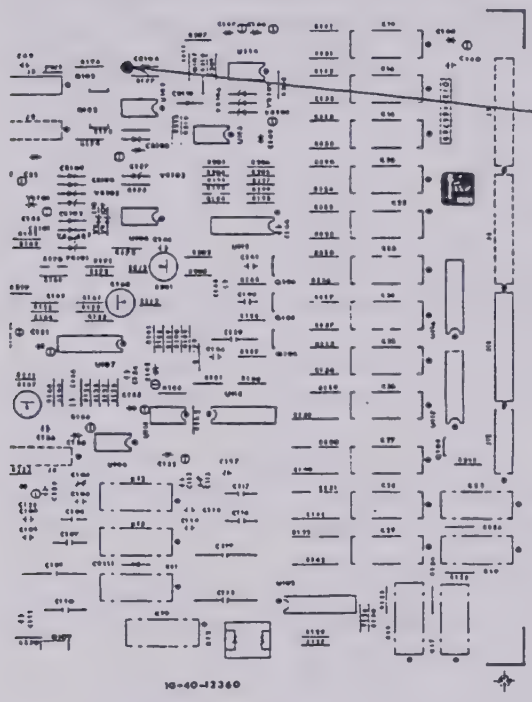
(6) Slowly turn R55 (DOWN1) and stop it when the input meter range changes from 3 V to 1 V range.

(7) Check that Auto Range switching point is correct when voltage of the voltage calibrator is increased or decreased.

(8) Change the measurement mode to LEVEL and set voltage of the voltage calibrator to 1.1 V. The level meter (the larger meter) reads 1.1 V (at 1 V range).

4.11 Tracking between OSC and ANALYZER

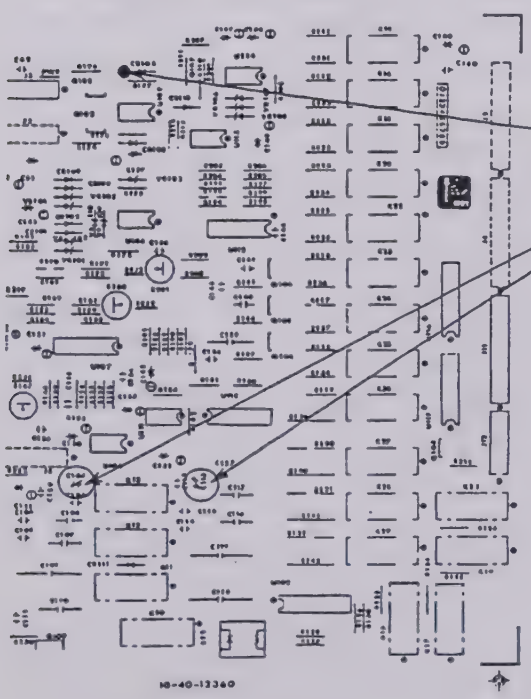
(1) Connect the OSC output and the A input terminal. Set the oscillator to the maximum output (4.0 dB). Set the measurement mode to DISTN and the input meter range, to 3 V. Carry out a distortion measurement.



Connect the oscilloscope to the MONITOR output pin. Also, connect an oscilloscope to the auto tuning voltage check point. Conduct the tracking adjustment while monitoring the distortion waveform and tuning voltage.

≪ANALYZER (A) ≫

(2) Tracking adjustment for 16 to 159.9 kHz bandwidth



Carry out the tracking adjustment for the bandwidth using trimmers C104 and C113 while monitoring the tuning voltage.
Set C104 around the middle capacity beforehand and use C113 for adjustment.
Turning voltage becomes minimum around 18, 21, 83.3 and 83.7 kHz and maximum around 158.8 and 159.8 kHz. Adjust so that the tuning voltage falls between 0.8 and 9.8 V throughout the entire bandwidth.
Check that tracking has been adjusted appropriately using the monitor output waveform.

≪ANALYZER (A) ≫

5. *TEST AND CALIBRATION PROCEDURE*

1. EQUIPMENT REQUIRED

Use the following calibrated equipment for test and calibration of the VP-7720A or VP-7721A.

Oscilloscope	Range of DC to 15 MHz or more, Sensitivity of 5 mV / div or more	Matsushita VP-5505B or equivalent
Frequency counter	Range of 5 Hz to 300 kHz	Matsushita VP- 4621A, VP-4545A or equivalent
AC deferential voltmeter	Range of 5 Hz to 2 MHz	Fluke 931A, 931B or equivalent
Distortion meter	Range of 5 Hz to 160 kHz, Sensitivity of 0.3 V rms or more, Measurement range of 0.01 % f.s. or more	Matsushita VP-7702C
Resistor attenuator	Attenuation of 79.9 dB or more at 0.1 dB steps, Characteristic impedance of 600 Ω	Ando AL-205 or equivalent
600 Ω terminator	Tolerance of 600 Ω ± 1 %	
AC voltage calibrator	Frequency of 1 kHz, Output voltage of 1000 V ± 0.3 % or less	Ballantine 421A or equivalent
Low-frequency oscillator	Wide range of 10 Hz to 10 MHz, Low distortion of 5 Hz to 99.9 kHz and 100 to 160 kHz	Matsushita VP-7720B, VP-725A or equivalent
Spectrum analyzer	70 dB or more at ranges between 10 Hz and 50 kHz and between 50 kHz and 600 kHz	
Digital multimeter	1 kHz AC and DC measurements, 3 V or more	Matsushita VP-2650A or equivalent
LCR meter		TEK 130 or equivalent
Low-pass filter box	15, 20, 50, 100 and 150 kHz	Matsushita

2.5 Output Amplitude Accuracy

The test setup is as shown below. Pay attention to noises caused by induction since extremely small voltage signals are used for measurements.

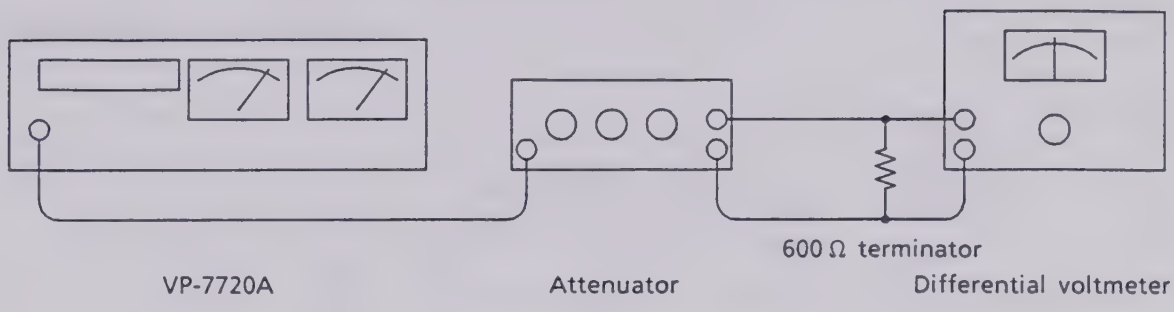


Figure 2 Output amplitude accuracy

Set the oscillating frequency of the VP-7720A or VP-7721A to 1 kHz and conduct the measurement using the substitution method shown in Figure 2. The frequency characteristics are specified separately.

2.6 Frequency Characteristics of Output Amplitude

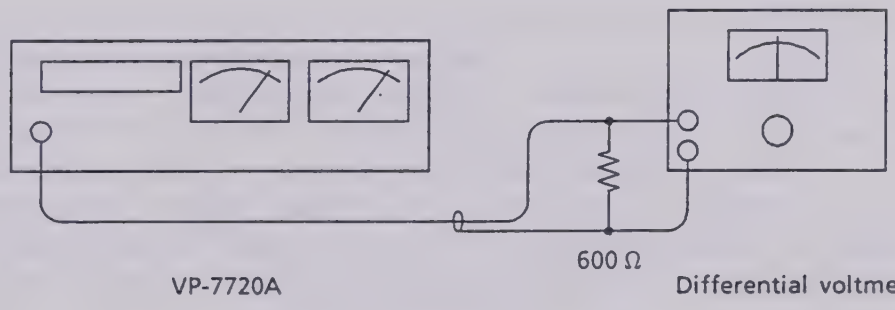


Figure 3 Frequency characteristics

(1) The test setup is as shown in Figure 3. Set the output voltage of the oscillator to the maximum (+ 4.0 dB).
(2) Adjust the differential voltmeter so that the voltmeter reading is ±0 % at the maximum output (4.0 dB) and 1 kHz (reference).
(3) Change the frequency of the oscillator and measure difference from the reference.

ANALYZER MEASUREMENT PROCEDURE

DISTORTION MEASUREMENT Select the DISTN mode using the mode selector.

2.9 Reference Wave Rejection Ratio

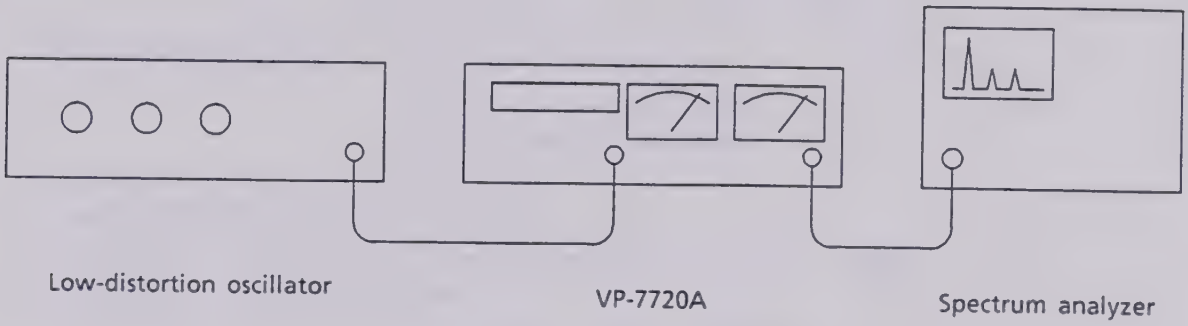
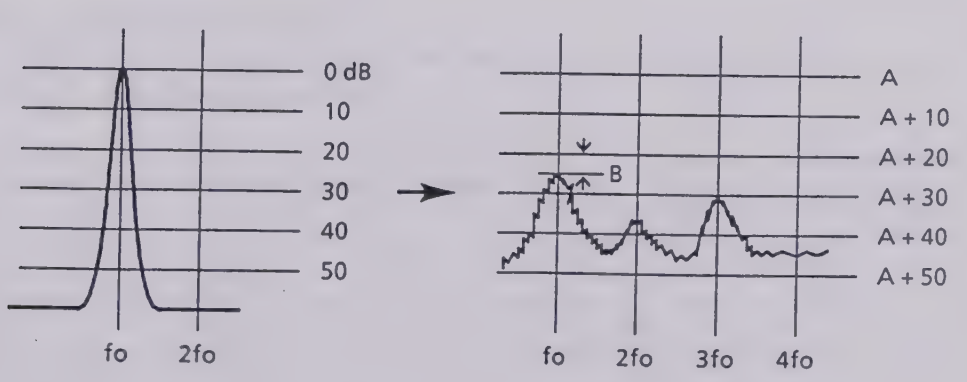


Figure 5 Common wave rejection ratio

(1) Supply a 3 V signal from the low-distortion oscillator to the VP-7720A or VP-7721A.
(2) Select the DISTN mode and set the input level range to 3 V and the distortion range, 100 %.
(3) Set the VP-7720A or VP-7721A to async (distortion meter reads 100 %) and measure the monitor output using the spectrum analyzer.
(4) Adjust the input sensitivity of the spectrum analyzer so that the reference wave is 0 dB.
(5) Set the VP-7720A or VP-7721A to the complete sync condition and gradually reduce the distortion range until the distortion meter reads an appropriate value.
(6) Calculate the reference wave rejection ratio from the distortion range (A) and the attenuation of the reference wave on the spectrum analyzer as shown below. Pay attention so that the spectrum analyzer is not saturated by the higher-order harmonics.



Async

Sync

Rejection ratio in this case is calculated as A + 20 + B (dB).

2.11.2 When input is floated (input to terminals A and B) (Only for VP-7721A)

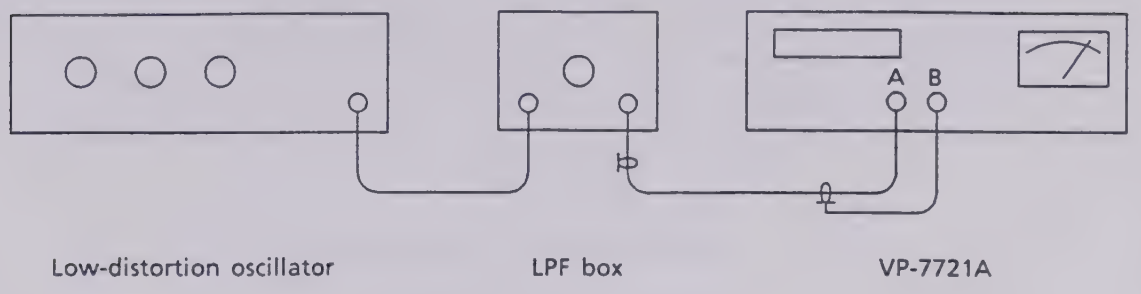


Figure 8 Residual distortion

(1) Set the VP7721A to the floating input.
(2) Supply the output from the low-distortion oscillator between inputs A and B of the VP-7721A and measure the distortion.
(3) For 15 kHz or more, insert the LPF box for reducing distortion of the oscillator.

Note : Conduct measurements carefully since results are easily affected by induction.

2.12 Input Level Meter Error

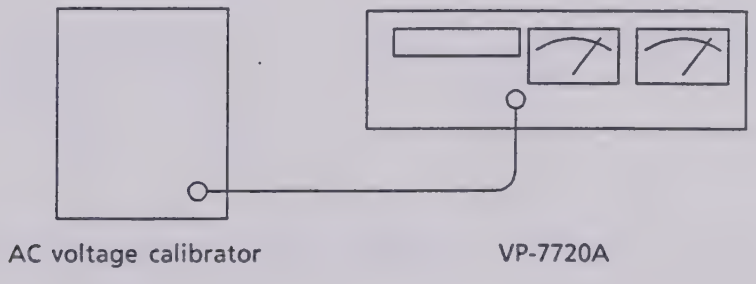
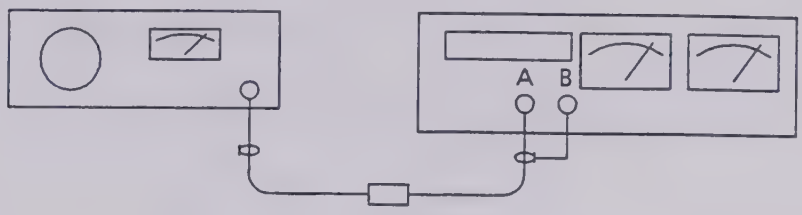


Figure 9 Input level meter error

(1) Set the input signal frequency to 1 kHz.
(2) Set the voltage calibrator to the output voltages listed in the table below and read the input level meter at each output voltage.

Calibrator output	Input range	Meter reading	Input range	Meter reading
100 V	100 V			
30 V	30 V		100 V	
10 V	10 V		30 V	
3 V	3 V		10 V	
1 V	1 V		3 V	
0.3 V	0.3 V		1 V	
0.1 V			0.3 V	

2.14.2 When input is floated (input to terminals A and B) (Only for VP-7721A)



Wide-band oscillator 50 Ω terminator VP-7721A

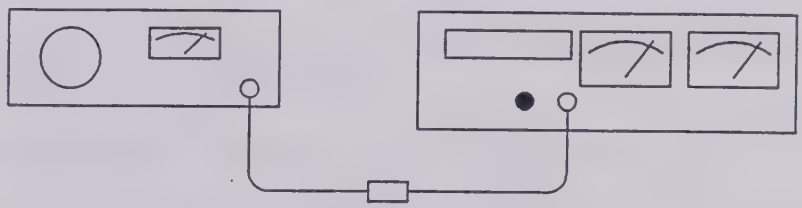
Figure 11 Frequency range

(1) The measurement procedure is same as that of 2.14.1, but the test setup is as shown in Figure 11.

2.15 Residual Noise

(1) Set the level meter range to 0.1 mV and short-circuit the input terminals.
(2) Read the level meter.

2.16 Reference Variable Range



Wide-band oscillator 50 Ω terminator VP-7720A

Figure 12 Reference variable range

(1) Supply a 1 kHz, 1 V signal from the wide-band oscillator to the VP-7720A or VP-7721A.
(2) Set the level meter range to 3 V.
(3) Turn the relative reference control counterclockwise all the way and pull it up.
(4) Read the meter. Next, turn the control clockwise all the way and read the meter. Difference of two meter readings is the reference variable range.

COMMON MEASUREMENT ITEMS

2.19 Input Impedance

2.19.1 Input impedance of VP-7720A or VP-7721A

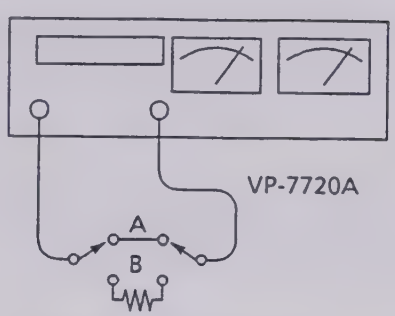


Figure 15 Input resistance

(1) Supply a 30 Hz, 1 V signal from the built-in oscillator to the VP-7720A or VP-7721A.
(2) Select the level mode and read the level meter when the switch shown in Figure 15 is set to circuit A.
(3) Next, set the switch to circuit B and read the level meter.
(4) Calculate the input resistance using the formula below.

$$\text{Input resistance} = (\text{Resistance B}) \times \frac{\text{Meter reading at B setting}}{(\text{Meter reading at A setting}) - (\text{Meter reading at B setting})}$$

(5) Connect the LC meter to the input terminal as shown in Figure 17 and measure the input capacities of ranges between 0.3 and 100 V.

2.19.2 When input is floated (input to terminals A and B) (Only for VP-7721A)

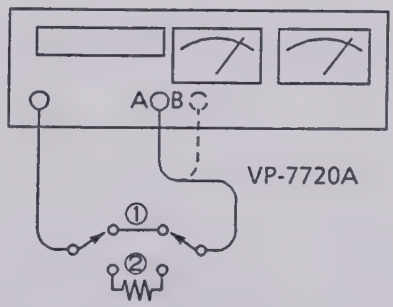


Figure 16 Input resistance

(1) Supply a 30 Hz, 1 V signal from the built-in oscillator to the VP-7721A.
(2) Select the level mode and read the level meter when the switch shown in Figure 16 is set to circuit (1). Next, set the switch to circuit (2) and read the level meter.
(3) Calculate the input resistance using the formula below.

$$\text{Input resistance} = (\text{Resistance of resistor (2)}) \times \frac{\text{Meter reading at (2) setting}}{(\text{Meter reading at (1) setting}) - (\text{Meter reading at (2) setting})}$$

(4) Measure input resistances of input terminals A and B.
(5) Connect the LC meter to the input terminal A or B and and measure the input capacity.

2.22 Output Impedance of AC and DC Output

(1) The test setup is the same as that shown in Figure 18.

(2) Read the output voltage on the digital multimeter when the AC or DC output is terminated by a 1 kΩ ±1 % resistor.

(3) Calculate the output impedance from the output voltage without termination measured in 2.21 and that with 1 kΩ termination measured in step (2) above and using the following formula.

Output impedance =

$$1000 \times \frac{\text{(Output voltage without termination)} - \text{(Output voltage with termination)}}{\text{Output voltage with termination}}$$

CHECK OF CONTROL FUNCTIONS

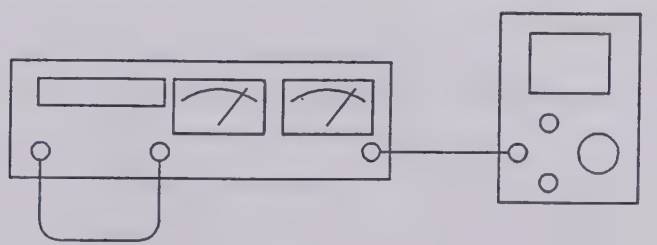
2.23 Preset and Remote

(1) Connect the control jig to the remote terminal and store data at 32 memory registers. Enter the following data to one register:

- Oscillator frequency
- Oscillator frequency range
- Oscillator output level
- Oscillator frequency or level indication
- Analyzer measurement mode
- Analyzer measuring filter
- Analyzer input level range
- Analyzer measurement range
- Analyzer Auto/Manual

(2) Turn the power off and then on. Check that data stored in the memory is not destroyed when the register is called. At this time, do not quickly turn power on and off.

TRACKING CHECK



VP-7720A Oscilloscope

Figure 19 Tracking check

(1) Select the DISTN mode. Check that the oscillator and the distortion meter are completely synchronized throughout the entire oscillation frequency range.

TEST REPORT

Audio Analyzer VP-7720A

Manufacturer: Electronic Measurement Division,
Matsushita Communication Industrial Co., Ltd.

ID. number _____

Date _____

Supervised by : _____

Tested by : _____

Mechanical performance

Item	Specification	Result
Appearance		
Dimensions	99 (H), 426 (W), 350 (D) (mm)	
Weight	Approx. 10 kg	

Electrical performance

Item	Specification	Result
Oscillator Section		
Frequency accuracy	Within ±3 % of reading Within ±2 % of reading in 0.16 kHz to 15.99 kHz range	
Output accuracy	4.0 dB to -35.9 dB Within ±0.5 dB -36 dB to -75.9 dB Within ±0.8 dB	
Flatness	Within ±0.3 dB Within ±0.1 dB from 20 Hz to 20 kHz	
Distortion	Full range 0.03 % or less 30 Hz to 40 kHz 0.005 % or less 50 Hz to 20 kHz (80 kHz BW) 0.002 % or less	

Item		Specification	Result
Analyzer Section			
Distortion	Fundamental rejection ratio	5 Hz to 15.99 kHz ≥100 dB 16 kHz to 50 kHz ≥ 90 dB 50 kHz to 159.9 kHz ≥ 86 dB	
	Second harmonic accuracy	5 Hz to 15.99 kHz Within ±1.5 dB 16 kHz to 50 kHz Within ±2.5 dB 50 kHz to 159.9 kHz Within +2.5, -4 dB	
	Residual distortion Ein ≥1 V rms	10 Hz to 15.99 kHz < -95 dB (80 kHz BW) 5 Hz to 50 kHz < -85 dB 50 kHz to 159.9 kHz < -65 dB	
Voltmeter	Indication accuracy	Within ±3 % of full scale	
	Flatness	20 Hz to 100 kHz Within ±0.5 dB 5 Hz to 500 kHz Within ±3 dB	
Signal to noise ratio	S/N measurement limit Ein ≥1 V	For oscillator setting from 5 Hz to 15.99 kHz : > 90 dB, >100 dB (80 kHz BW) For oscillator setting from 16 kHz to 159.9 kHz : > 80 dB	
Others	Input impedance	100 kilohms shunted by < 150 pF	
	Filters	30 kHz, 80 kHz LPF 400 Hz HPF	
	AC/DC output	Approx. 1 V rms/1 V DC	
Others			
Preset / Recall			
Remote control			
Tuning of interlocked oscillator and rejection filter			
Insulation resistance		DC 500 V 10 megohms or more	
Dielectric withstanding voltage		DC 500 V	
Power consumption		Approx. 30 VA	

TEST REPORT

Audio Analyzer VP-7721A

Manufacturer: Electronic Measurement Division,
Matsushita Communication Industrial Co.,Ltd.

ID.number _____

Date _____

Supervised by: _____

Tested by: _____

Mechanical performance

Item	Specification	Result
Appearance		
Dimensions	99 (H), 426 (W), 350 (D) (mm)	
Mass	Approx. 10 kg	

Electrical performance

Item	Specification	Result
Oscillator section		
Frequency accuracy	Within ± 3% of reading Within ± 2% of reading in 0.16kHz to 15.99kHz range	
Output accuracy	4.0dB to -35.9dB Within ± 0.5dB -36dB to -75.9dB Within ± 0.8dB	
Flatness	Within ±0.3dB Within ±0.1dB from 20Hz to 20kHz	
Distortion	Full range 0.03% or less 30Hz to 40kHz 0.005% or less 50Hz to 20kHz(80kHz BW) 0.002% or less	

Item		Specification	Result
Analyzer section			
Distortion	Fundamental rejection ratio	5Hz to 15.99kHz ≧100dB 16kHz to 50kHz ≧ 90dB 50Hz to 159.9kHz ≧ 86dB	
	Second harmonic accuracy	5Hz to 15.99kHz Within ±1.5dB 16kHz to 50kHz Within ±2.5dB 50Hz to 159.9kHz Within +2.5,-4dB	
	Residual distortion Ein≧1V rms (Non-floating input)	10Hz to 15.99kHz <-95dB (80kHz BW) 5Hz to 50kHz <-85dB 50Hz to 159.9kHz <-65dB	
Voltmeter	Indication accuracy	Within ±3% of full scale	
	Flatness	20Hz to 100kHz Within ±0.5dB 5Hz to 500kHz Within ±3dB	
Signal to noise ratio	S/N measurement limit Ein≧1V	For oscillator setting from 5Hz to 15.99kHz: >90dB, >100dB(80kHz BW) For oscillator setting from 16kHz to 159.9kHz: >80dB	
Others	Input impedance	100 kilohms shunted by <150pF	
	Filters	30kHz, 80kHz LPF 400Hz HPF	
	AC/DC output	Approx. 1V rms/ 1V DC	
Others			
Preset/Recall			
Remote control			
Tuning of interlocked oscillator and rejection filter			
Insulation resistance		DC 500V 10 megohms or more	
Dielectric withstanding voltage		DC 500V 1 minute	
Power consumption		Approx. 30VA	

Item	Specification	Remark
Emission section		
Distortion	Fundamental	5Hz to 15.99kHz ≥ 2100dB
	reduction ratio	16kHz to 30kHz ≥ 90dB
		50kHz to 110.15kHz ≥ 80dB
	Second harmonic	5Hz to 15.95kHz Within ±1.5dB
	accuracy	16kHz to 30kHz Within ±2.5dB
		50kHz to 110.0kHz Within +5.5, -6dB
	Residual	10Hz to 15.95kHz <-95dB
	distortion	(Inside DF)
	Ellipse rec	30k to 90kHz <-45dB
	(Non-floating input)	90kHz to 110.0kHz <-45dB
Voltmeter	Indication accuracy	Within ±30% of full scale
	Flatness	20Hz to 20kHz Within ±0.5dB
		5Hz to 500kHz Within ±3dB
Signal to noise ratio	S/N measurement limit	For oscillator setting free 5Hz to 15.99kHz:
	Ellipse	2900M, 2100dB(20kHz BW)
		For oscillator setting free 16kHz to 100 90kHz
		2dBm
Others	Input impedance	100 kilohms minimum by <150pF
	Filters	300Hz, 400Hz LPF
		400Hz HPF
	AC/DC output	Ripple: 1% rms/ 1V DC
Others		
Preset Panel		
Remote control		
Timing of interlocked oscillator and reduction filter		
Insulation resistance	DC 500V 10 megohms or more	
Dielectric withstanding voltage	AC 500V 1 minute	
Power consumption	Approx. 250W	

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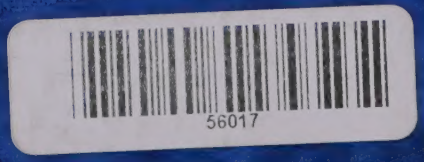
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